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Ijima

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(54) **RECEPTACLE CONNECTOR**

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H01R 13/627 (2006.01)
H01R 13/639 (2006.01)
H01R 13/635 (2006.01)

(52) **U.S. Cl.**
CPC ***H01R 13/639*** (2013.01); ***H01R 13/6276*** (2013.01); ***H01R 13/635*** (2013.01)
USPC **439/348**; 439/319

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CPC H01R 13/623; H01R 13/625; H01R 13/6275; H01R 13/6276; H01R 13/635; H01R 13/639; H01R 39/643
USPC 439/258, 319, 345–348, 350, 352
See application file for complete search history.

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(57) **ABSTRACT**

A receptacle connector **10** has a first holding mechanism **17** for holding a plug **50** connected to a holder **12** by fitting a ball **16** disposed in a hole **12**D defined in the holder **12** into a hole **52**A defined in a second shell **52** of the plug **50** through a recess **11**E defined in the outer circumferential surface of a first body **11**, and a second holding mechanism **18** for coacting with the first holding mechanism **17** to keep the plug **50** and the holder connectable to and releasable from each other.

5 Claims, 9 Drawing Sheets

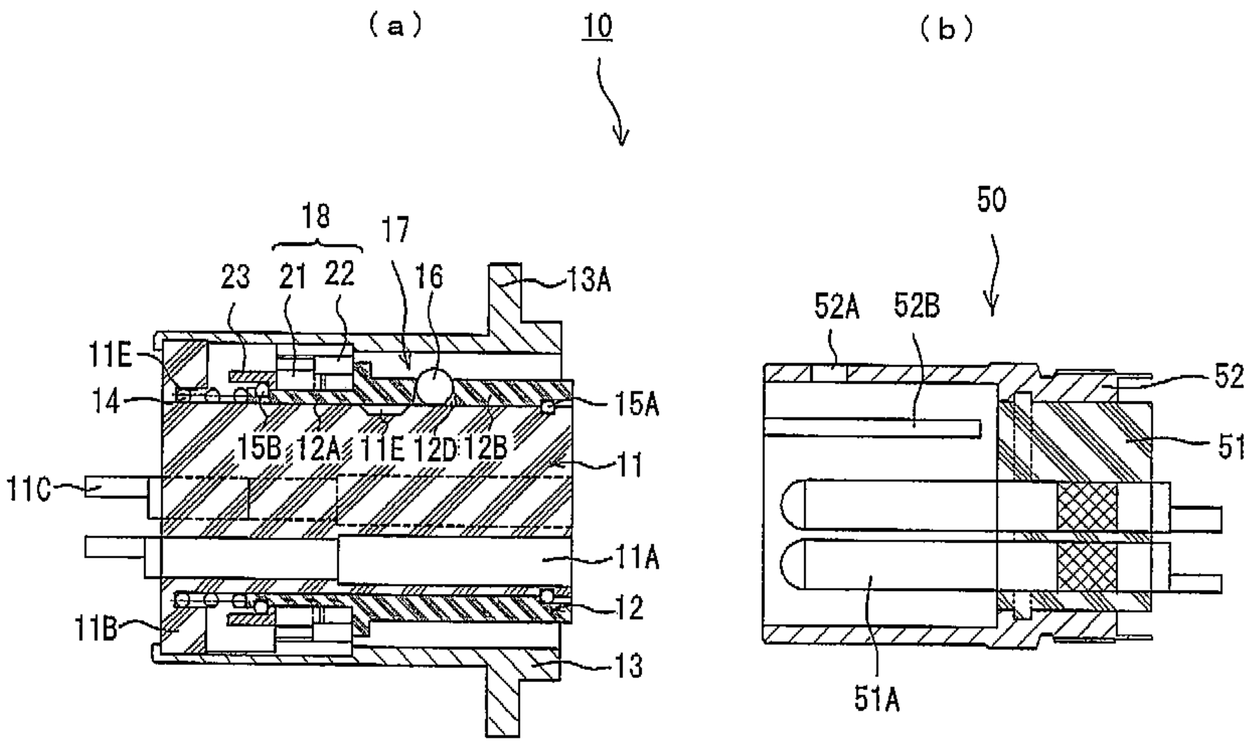


Fig. 1

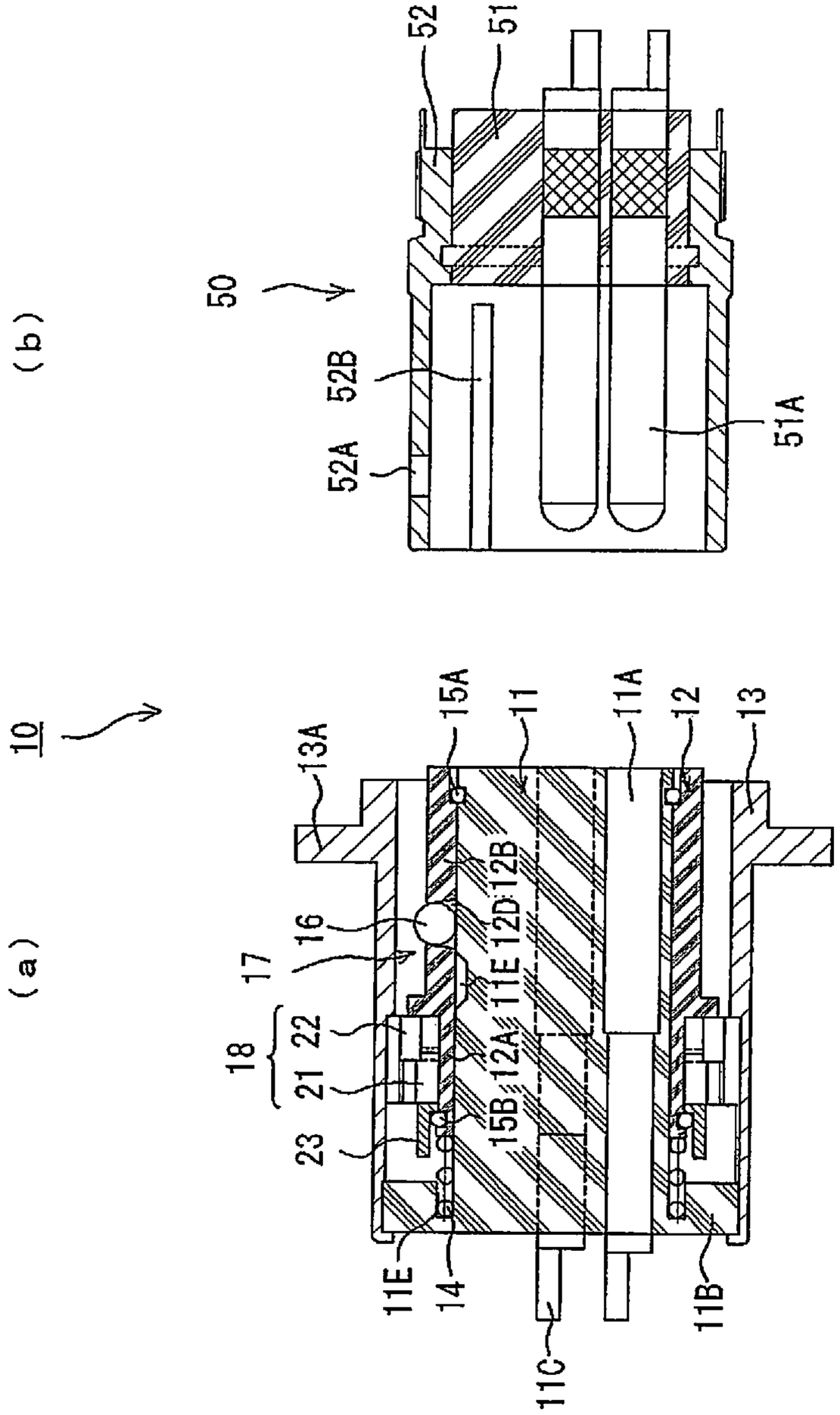

(a)
10
(b)
50
52
51
52B
52A
51A
13A
15A
11
11A
12
13
16
17
18
22
21
23
12B
12D
11E
12A
15B
14
11C
11B

Fig. 2

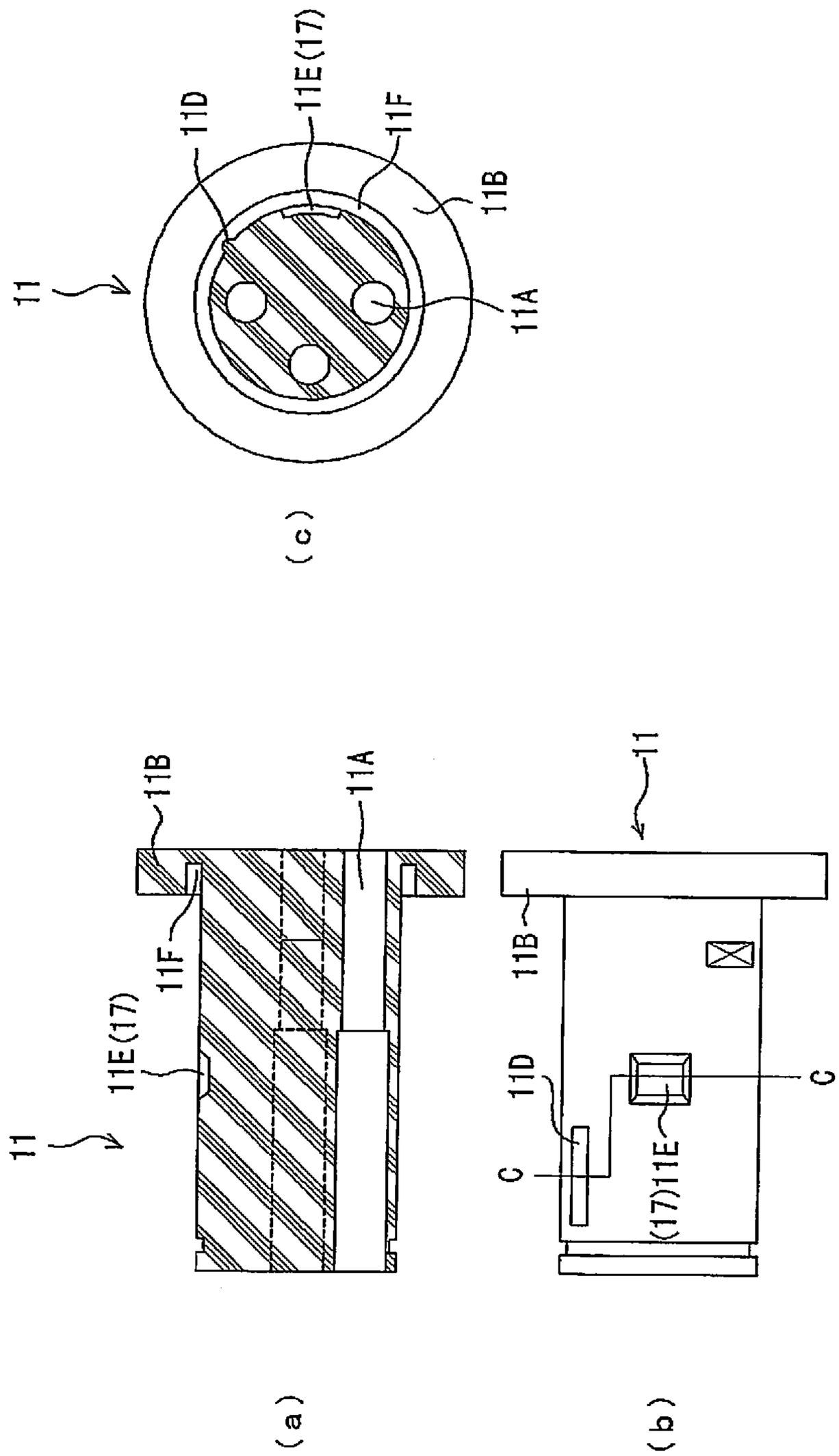


Fig. 3

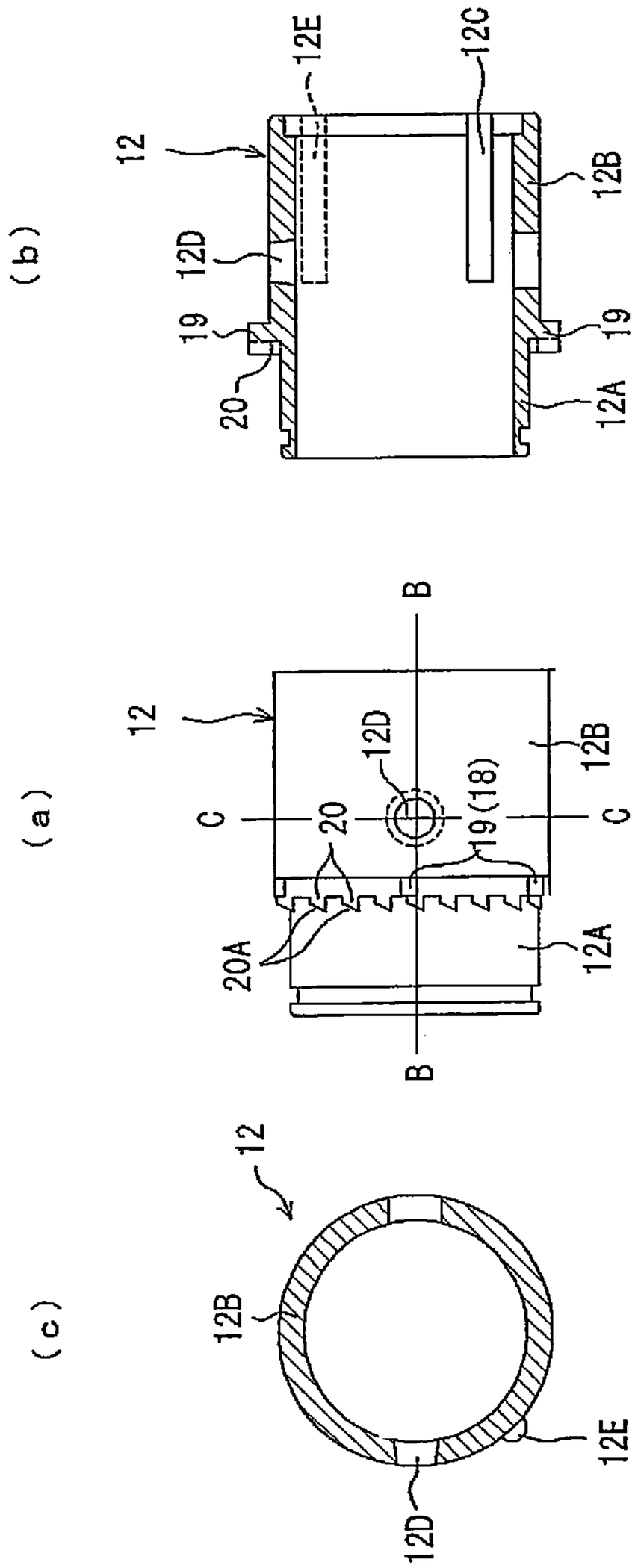
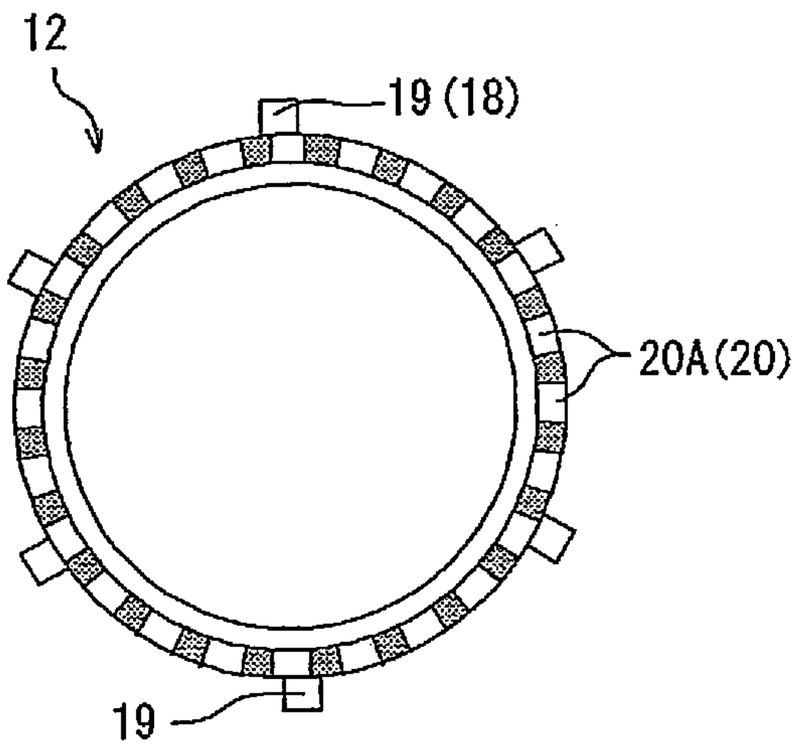


Fig. 4

(a)



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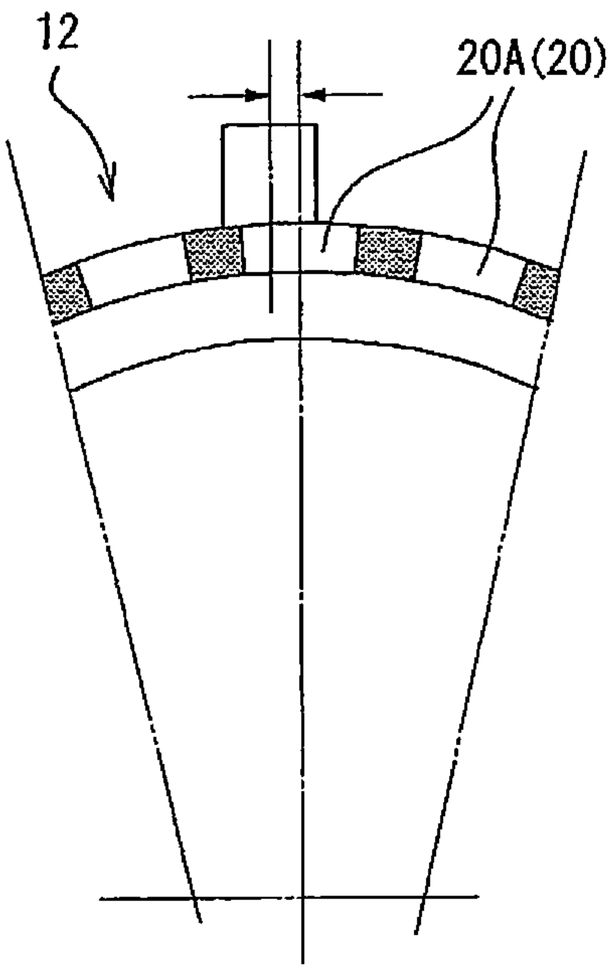
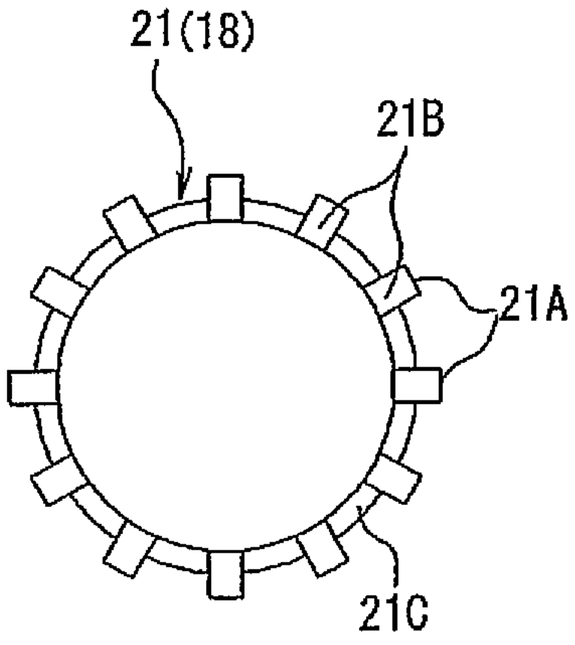
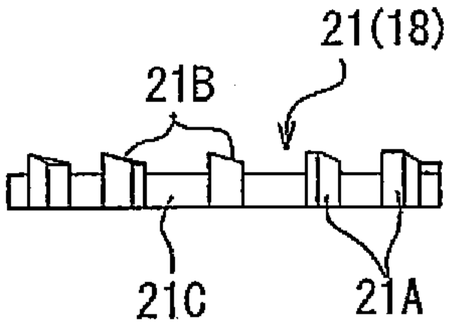


Fig. 5

(c)



(a)



(b)

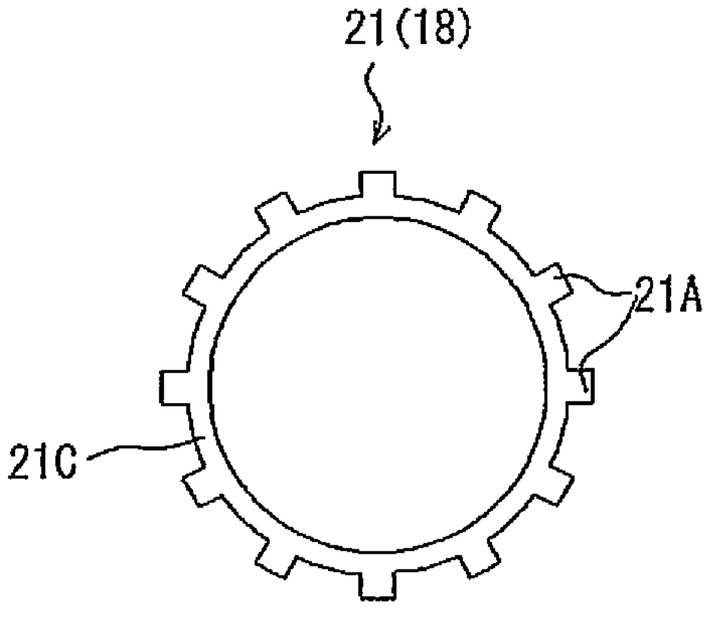


Fig. 6

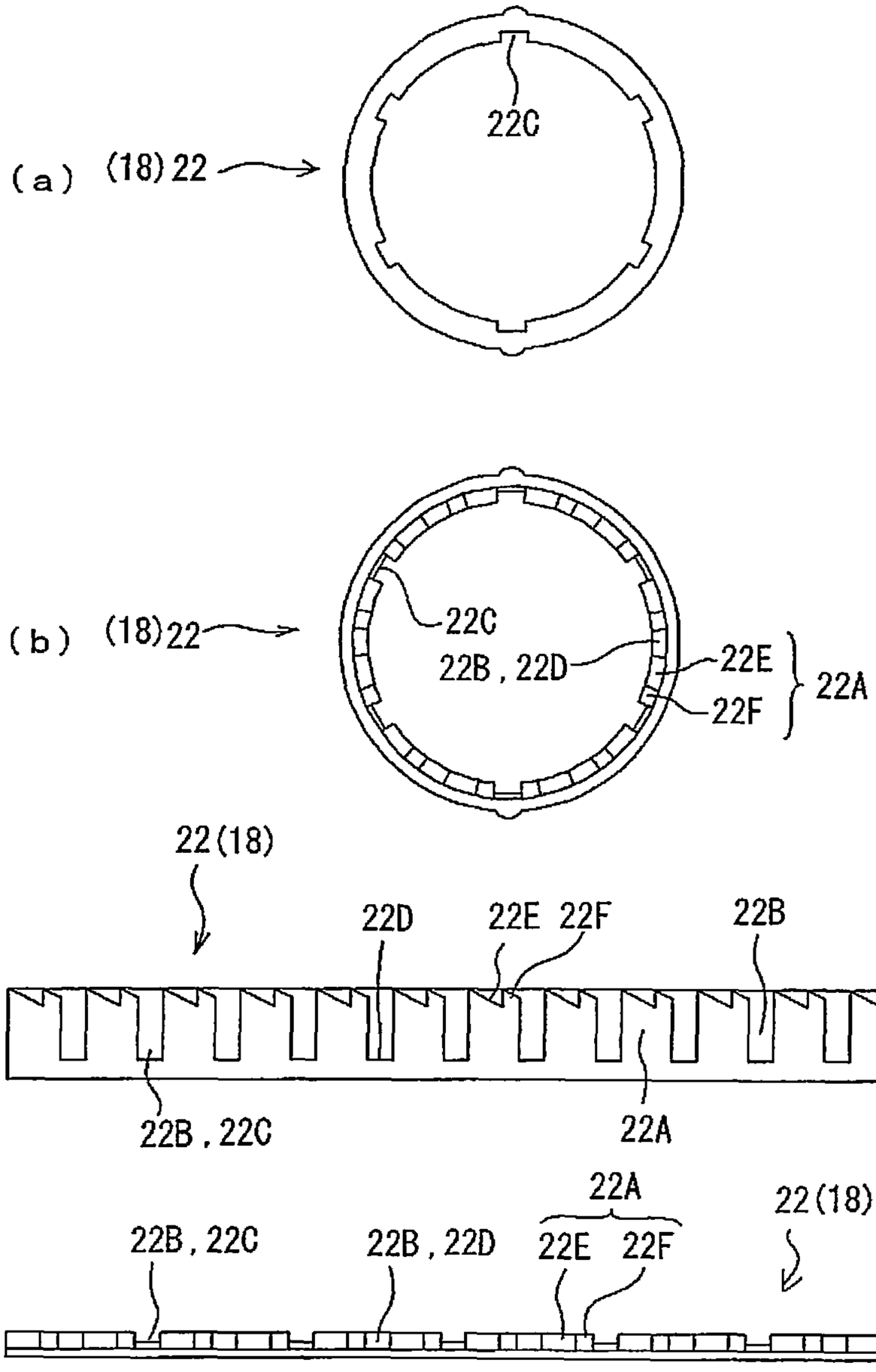
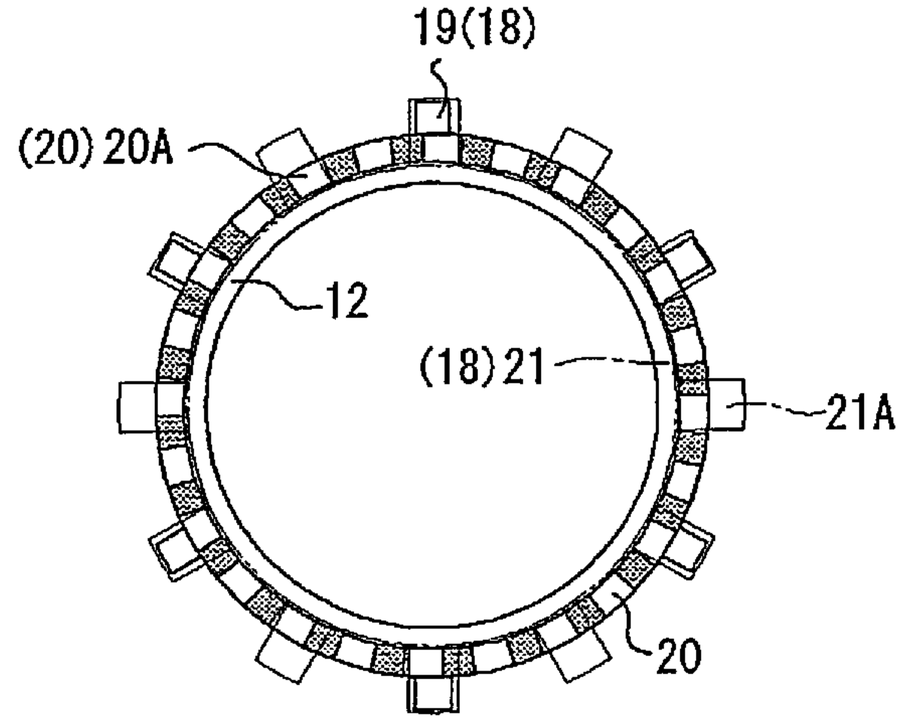

(a)
(18)22
22C
(b)
(18)22
22C
22B , 22D
22E
22F
22A
22(18)
22D
22E 22F
22B
(c)
22B , 22C
22A
22A
22(18)
22B , 22C
22B , 22D
22E 22F
(d)

Fig. 7

(a)



(b)

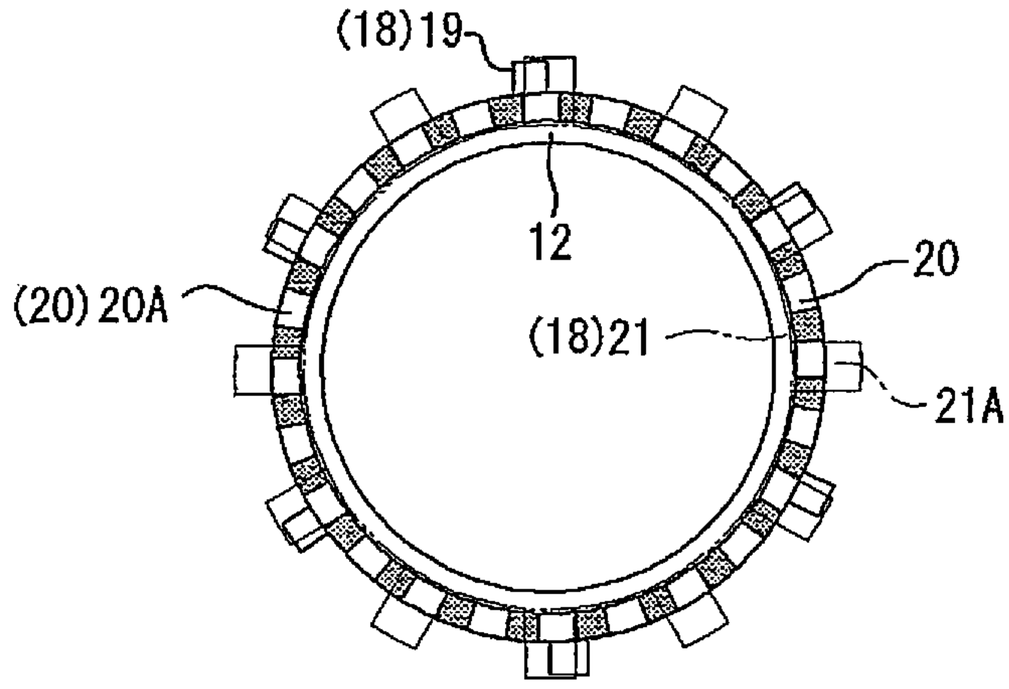
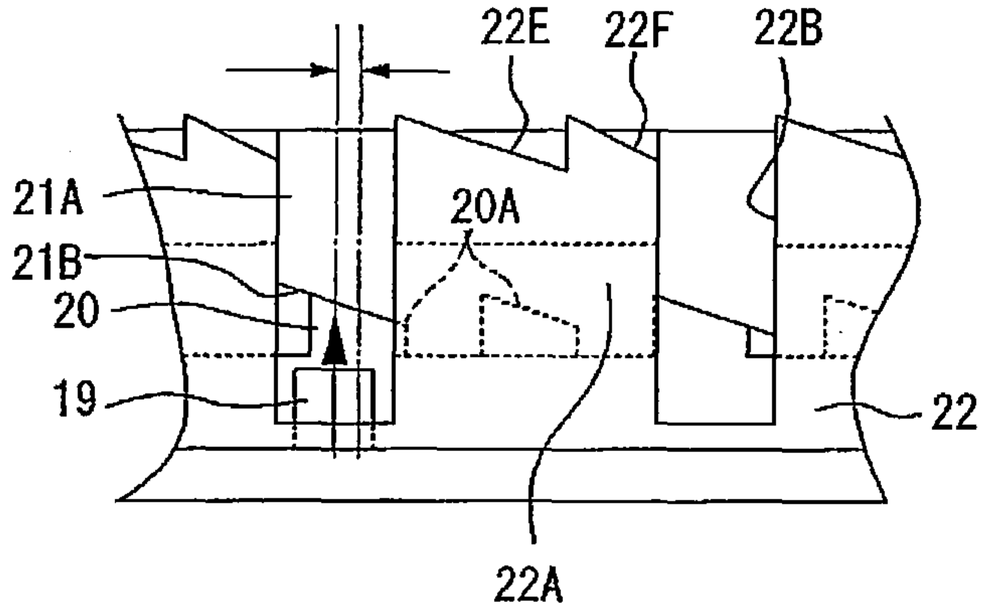


Fig. 8

(a)


22E
22F
22B
21A
20A
21B
20
19
22
22A

(b)

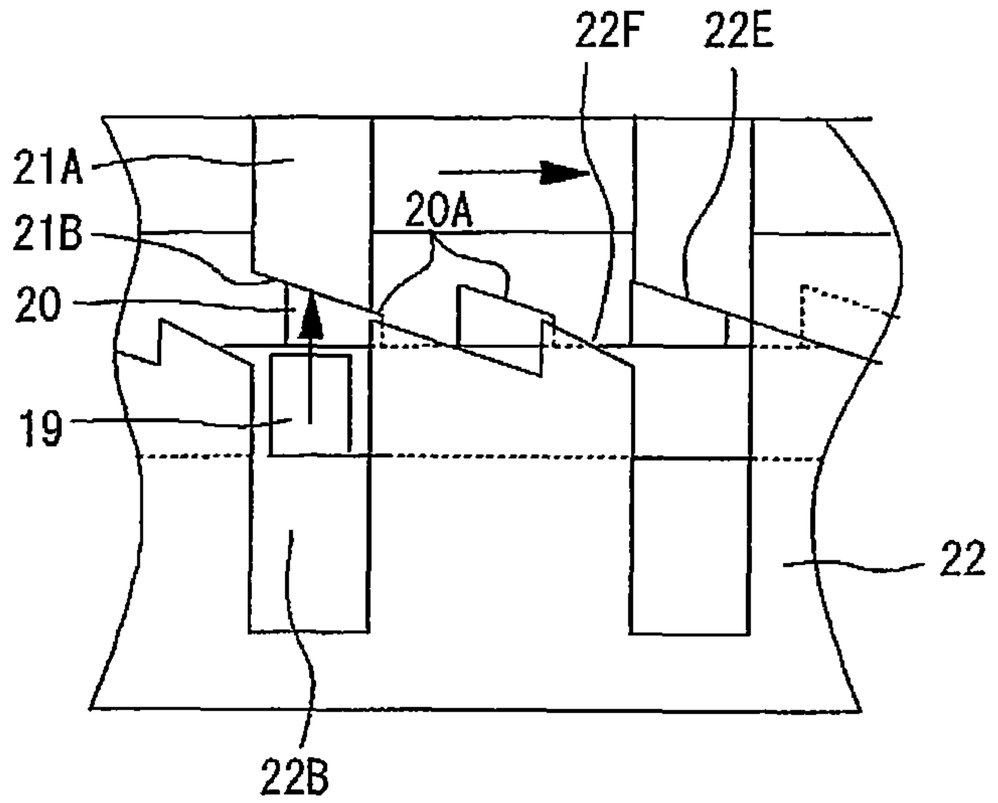
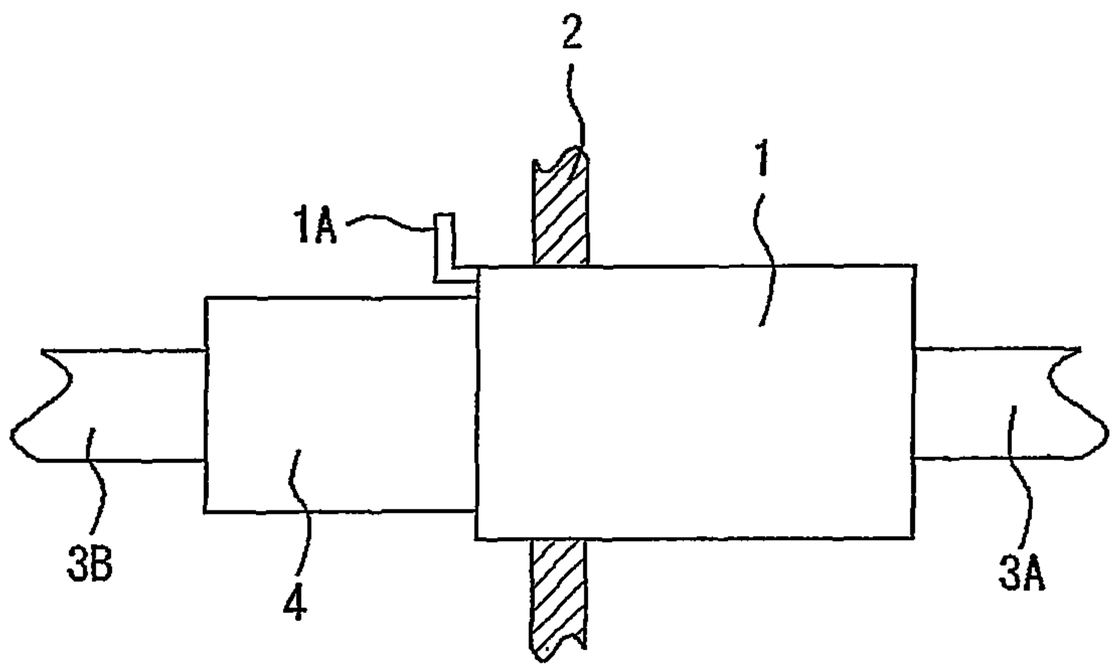

22F
22E
21A
20A
21B
20
19
22
22B

Fig. 9
PRIOR ART



RECEPTACLE CONNECTOR

TECHNICAL FIELD

The present invention relates to a receptacle connector for connecting to devices for sending and receiving audio and video signals, and more particularly to a receptacle connector which allows a plug to be easily connected thereto and removed therefrom.

BACKGROUND ART

Heretofore, a receptacle connector shown in FIG. **9** of the accompanying drawings, which is of the type described above, has been in widespread use in the art. The receptacle connector will be described below with reference to FIG. **9**. As shown in FIG. **9**, the receptacle connector according to the background art, denoted by **1**, is used as being fixed to a panel **2** of a device for sending and receiving audio and video signals. Communication cables **3**A, **3**B for audio and video signals are connected to each other by inserting a plug **4** into the receptacle connector **1**. When the plug **4** is inserted into the receptacle connector **1**, a lock mechanism (not shown) is actuated to keep the receptacle connector **1** and the plug **4** connected for thereby locking the plug **4** against removal from the receptacle connector **1**.

For removing the plug **4** from the receptacle connector **1**, the user pushes a lever **1**A with one hand to release the lock mechanism, and then grips the plug **4** with the other hand and pulls the plug **4** from the receptacle connector **1**.

DISCLOSURE OF THE INVENTION

Problems to be Solved by the Invention

Since the user needs to push the lever **1**A with one hand to release the lock mechanism and then pull the plug **4** from the receptacle connector **1** with the other hand, the user has to operate the lever **1**A of the receptacle connector **1** each time the user connects the plug **4** to the receptacle connector **1** and pulls the plug **4** from the receptacle connector **1**.

The present invention has been made in view of the above problems. It is an object of the present invention to provide a receptacle connector which allows a plug to be easily connected thereto and removed therefrom, and which securely prevents the plug from being dislodged from the receptacle connector.

Means for Solving the Problems

In accordance with (1) of the present invention, a receptacle connector includes a first body having a pin hole for inserting therein a pin of a plug for electrical connection thereto, a tubular holder having a thinner portion disposed on a proximal end side thereof and a thicker portion disposed on a distal end side portion thereof with a step interposed therebetween, the tubular holder being slidable along the first body, a tubular first shell having an end fixed to a large-diameter portion on a proximal end of the first body and another end extending to a distal end of the holder, a helical spring resiliently disposed between the large-diameter portion and the proximal end of the holder, a stop ring for preventing the holder biased by the helical spring from being dislodged from the first body, a first holding mechanism for holding the plug connected to the holder by fitting a ball disposed in a hole defined in the holder into a hole defined in a second shell of the plug through a recess defined in an outer

circumferential surface of the first body, and a second holding mechanism for coacting with the first holding mechanism to keep the plug and the holder connectable to and releasable from each other, wherein when the plug is pushed in between the holder and the first shell against the bias of the helical spring, the first holding mechanism is actuated to fix the plug to the holder and the second holding mechanism holds the plug and the holder connected to each other, and when the plug is pushed in against the bias of the helical spring while the plug and the holder are connected to each other, the second holding mechanism releases the plug and the holder from each other and the first holding mechanism is actuated to release the plug and the holder from each other, the second holding mechanism including a plurality of radially outward fingers projecting radially outwardly from a circumferential surface of the thicker portion of the step of the holder and circumferentially spaced at equal intervals, a plurality of first engaging teeth projecting from the step of the thicker portion of the holder toward the proximal end and circumferentially spaced at equal intervals, the first engaging teeth being circumferentially displaced from the radially outward fingers by a predetermined angle, a first ring rotatably disposed between the large-diameter portion of the first body and the first engaging teeth of the holder and having a plurality of second engaging teeth engaging circumferentially slanted surfaces of the first engaging teeth, and a bushing positioned on an inner circumferential surface of the first shell between the first and second engaging teeth and having third engaging teeth for engaging circumferentially slanted surfaces of the second engaging teeth to rotate the first ring circumferentially, wherein the bushing has a plurality of cavities defined in an inner circumferential surface thereof for passing therein the radially outward fingers and fitting grooves defined in the inner circumferential surface thereof for allowing the second engaging teeth to move into and out of the fitting grooves.

In accordance with (2) of the present invention, in a receptacle connector according to (1), the third engaging teeth of the bushing has slanted surfaces circumferentially longer than the slanted surfaces of the second engaging teeth of the first ring, and engaging portions disposed on respective extension ends of the slanted surfaces for stopping the first ring against rotation.

In accordance with (3) of the present invention, in a receptacle connector according to (1) or (2), the first engaging teeth have a width representing the sum of the widths of at least the radially outward fingers and the second engaging teeth disposed inwardly of the radially outward fingers.

In accordance with (4) of the present invention, in a receptacle connector according to (2) or (3), the engaging portions of the third engaging teeth have, on projecting ends thereof, slanted surfaces for guiding the second engaging teeth into the fitting grooves.

In accordance with (5) of the present invention, in a receptacle connector according to any one of (1) through (4), the first holding mechanism includes the ball removably disposed in the hole defined in the thicker portion of the holder, for being fitted into the hole defined in the plug to connect the plug to the holder, and the recess defined in the outer circumferential surface of the first body for receiving the ball retracted therein while the ball is disposed in the hole of the holder which slides against the helical spring.

Advantages of the Invention

According to the present invention, there is provided a receptacle connector which allows a plug to be easily con-

nected thereto and removed therefrom, and which securely prevents the plug from being dislodged from the receptacle connector.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an axial cross-sectional view of a receptacle connector according to an embodiment of the present invention and a plug;

FIGS. **2**(*a*) through **2**(*c*) are views of a first body of the receptacle connector shown in FIG. **1**, FIG. **2**(*a*) being a cross-sectional view taken along the axis thereof, FIG. **2**(*b*) a side elevational view of a central portion thereof, and FIG. **2**(*c*) a cross-sectional view taken along line C-C of FIG. **2**(*b*);

FIGS. **3**(*a*) through **3**(*c*) are view of a holder of the receptacle connector shown in FIG. **1**, FIG. **3**(*a*) being a side elevational view of a central portion thereof, FIG. **3**(*b*) a cross-sectional view taken along line B-B of FIG. **3**(*a*), and FIG. **3**(*c*) a cross-sectional view taken along line C-C of FIG. **3**(*a*);

FIGS. **4**(*a*) and **4**(*b*) are views of the holder shown in FIGS. **3**(*a*) through **3**(*c*), FIG. **4**(*a*) being a front elevational view of a left end of the holder shown in FIG. **3**(*a*), and FIG. **4**(*b*) an enlarged fragmentary view of the holder shown in FIG. **4**(*a*);

FIGS. **5**(*a*) through **5**(*c*) are views of a first ring of the receptacle connector shown in FIG. **1**, FIG. **5**(*a*) being a side elevational view thereof, FIG. **5**(*b*) a front elevational view of a lower end of the first ring shown in FIG. **5**(*a*), and FIG. **5**(*c*) a front elevational view of an upper end of the first ring shown in FIG. **5**(*a*);

FIGS. **6**(*a*) through **6**(*d*) are views of a bushing of the receptacle connector shown in FIG. **1**, FIG. **6**(*a*) being a front elevational view of a front end side of the receptacle connector, FIG. **6**(*b*) a front elevational view of an opposite side of the receptacle connector, FIG. **6**(*c*) a developed view of a side surface of the receptacle connector, and FIG. **6**(*d*) a developed view of the opposite side shown in FIG. **6**(*b*);

FIGS. **7**(*a*) and **7**(*b*) are views illustrative of the relationship between the holder shown in FIGS. **3**(*a*) through **3**(*c*) and the first ring shown in FIGS. **5**(*a*) through **5**(*c*);

FIGS. **8**(*a*) and **8**(*b*) are views illustrative of the relationship between the holder, the first ring, and the bushing; and

FIG. **9** is a side elevational view of a receptacle connector according to the background art and a plug which are connected to each other.

MODE FOR CARRYING OUT THE INVENTION

A receptacle connector according to an embodiment of the present invention shown in FIGS. **1** through **8**(*a*), **8**(*b*) will be described below. As shown in FIG. **1**, the receptacle connector, denoted by **10**, according to the embodiment is used to connect communication cables for audio and video signals through a plug **50**, and allows the plug **50** to be easily connected and removed as described later.

The receptacle connector **10** according to the present embodiment and the plug **50** will be described below. As shown in FIG. **1**, the receptacle connector **10** includes a first body **11** having a plurality of (e.g., three) pin holes **11**A for electrical connection to pins of the plug **50**, a tubular holder **12** having a thinner portion **12**A on a proximal end side thereof (left side in FIG. **1**) and a thicker portion **12**B on a distal end side thereof (right side in FIG. **1**) with a step interposed therebetween, the tubular holder **12** being slidable along the first body **11**, a tubular first shell **13** having an end fixed to a flange **11**B on the proximal end of the first body **11** and the other end extending to the distal end of the holder **12**, a helical spring **14** resiliently disposed between the large-diameter portion (flange) **11**B of the first body **11** and the proximal end of the holder **12**, and a stop ring **15**A for preventing the holder **12** biased by the helical spring **14** from being dislodged from the first body **11**. The first shell **13** has a flange **13**A on a distal end portion thereof. The receptacle connector **10** is fixed to a panel (not shown) by the flange **13**A.

As shown in FIGS. **2**(*a*) and **2**(*c*), the first body **11** is in the form of a cylinder of synthetic resin. As shown in FIG. **2**(*a*), the three pin holes **11**A extend axially through the first body **11** and are spaced from each other. As shown in FIG. **2**(*c*), the three pin holes **11**A jointly make up a triangular shape at a distal end surface. Sheath-like conductor terminals are mounted on the inner circumferential surfaces of the pin holes **11**A, and connection pins **11**C (see FIG. **1**) for connection to cables (not shown) extend from the conductor terminals. As shown in FIG. **1** at (a), the first body **11** is covered by the holder **12**, which is slidable on the outer circumferential surface of the first body **11**.

As shown in FIGS. **2**(*b*) and **2**(*c*), the first body **11** has a ridge **11**D extending axially on a distal end portion of the circumferential surface thereof. The holder **12** has a groove **12**C defined in the inner circumferential surface thereof and extending axially from the distal end to an intermediate position, as shown in FIG. **3**(*b*), in alignment with the ridge **11**D. With the ridge **11**D engaging in the groove **12**C, the holder **12** which is mounted on the first body **11** is resiliently biased to move straight by the helical spring **14**. The ridge **11**D and the groove **12**C also perform a positioning function at the time the holder **12** is mounted on the first body **11**.

As shown in FIGS. **1** and **3**, the thicker portion **12**B of the holder **12** has a hole **12**D defined therein. As shown in FIG. **1**, a ball **16** for connecting the plug **50** is disposed in the hole **12**D. As shown in FIG. **3**, the hole **12**D is gradually tapered off from the inner circumferential surface toward outer circumferential surface of the holder **12**. As shown in FIG. **1**, when the holder **12** is in an initial state, the ball **16** is held in contact with the outer circumferential surface of the first body **11** and partly projects from the hole **12**D in the holder **12**. The ball **16** fits into a recess **11**E defined in the circumferential surface of the first body **11** and, while in the hole **12**D, is retracted from the circumferential surface of the holder **12**. The recess **11**E is spaced from the hole **12**D toward the proximal end when the holder **12** is in the initial state. When the holder **12** is pushed in toward the proximal end against the bias of the helical spring **14**, the ball **16** is retracted from the hole **12**D into the recess **11**E.

As shown in FIG. **1**, the helical spring **14** has an end fitted in and supported by an annular groove **11**F (see FIG. **2**(*a*)) defined in the flange **11**B of the first body **11** and the other end supported by the distal end of the holder **12**.

As shown in FIG. **1**, the plug **50** includes a second body **52** having a plurality of (three in the present embodiment) pins **51**A corresponding respectively to the pin holes **11**A in the first body **11**, and a second shell **52** extending from a proximal end portion (right side in FIG. **1** at (b)) of the circumferential surface of the second body **51** to a position slightly ahead of the distal ends of the three pins **51**A. The second shell **52** has an inside diameter slightly greater than the holder **12** and an outside diameter slightly smaller than the inside diameter of the first shell **13**. When the plug **50** is connected, it is inserted into the clearance between the holder **12** and the first shell **13**, with the pins **51**A inserted in the pin holes **11**A. The second shell **52** has a hole **52**A defined therein near the distal end thereof for receiving an upper portion of the ball **16** fitted therein. The ball **16** which projects from the circumferential surface of the holder **12** is fitted into the hole **52**A, thereby

connecting the plug **50** to the receptacle connector **10**. As shown in FIG. **1** at (a) and (b), the second shell **52** has a groove **52**B defined in the inner circumferential surface thereof and extending from the distal end toward the proximal end thereof. As shown in FIG. **3**(*c*), the holder **12** has a ridge **12**E disposed on the outer circumferential surface thereof and held in alignment with the groove **52**B. When the plug **50** is connected to the receptacle connector **10**, the groove **52**B and the ridge **12**E serve to position them.

The receptacle connector **10** has first and second holding mechanisms **17**, **18** that function when the plug **50** is connected. Only by pushing the second shell **52** into the clearance between the holder **12** and the first shell **13**, the first and second holding mechanisms **17**, **18** function to simply connect the plug **50** to the receptacle connector **10**. The plug **50** can also be pulled out of the receptacle connector **10** only by pushing in the plug **50**. The first and second holding mechanisms **17**, **18** will be described below.

As shown in FIGS. **1** through **3**, the first holding mechanism **17** includes the ball **16** which is movably disposed in the hole **12**D defined in the thicker portion **12**B of the holder **12** and fitted in the hole **52**A defined in the plug **50**, and the recess **11**E defined in the outer circumferential surface of the first body **11** for receiving the ball **16** in the hole **12**D defined in the holder **12** that slides against the helical spring **14**. When the plug **50** is pushed into the holder **12** against the bias of the helical spring **14**, the ball **16** in the hole **12**D in the holder **12** is retracted into the recess **11**E defined in the first body **11**. Thereafter, when the holder **12** is pushed back under the bias of the helical spring **14**, the ball **16** moves out of the recess **12**D and projects into the hole **52**A in the plug **50**, connecting the plug **50** to the holder **12**, i.e., the receptacle connector **10**, and keep them connected. For removing the plug **50**, the plug **50** is pushed in, causing the holder **12** to slide against the bias of the helical spring **14**. The ball **16** is retracted into the recess **11**E, disconnecting the plug **50** and allowing the plug **50** to be removed.

The second holding mechanism **18** functions to keep the plug **50** connectable or removable when the plug **50** is inserted into the clearance between the holder **12** and the first shell **13** to connect the plug **50** to the receptacle connector **10**. Specifically, as shown in FIGS. **1** through **6**, the second holding mechanism **18** includes a plurality of (six in the present embodiment) radially outward fingers **19** (see FIGS. **3** and **4**) radially outwardly projecting from the end face of the step of the thicker portion **12**B of the holder **12** and circumferentially spaced at equal intervals, a plurality of (twenty four in the present embodiment) first engaging teeth **20** (see FIG. **3**) circumferentially spaced at equal intervals and projecting from the step of the thicker portion **12**B of the holder **12** toward the proximal end, the first engaging teeth **20** being circumferentially slightly displaced from the radially outward fingers **19** by a certain angle, a first ring **21** (see FIGS. **1** and **5**) rotatably disposed between the flange **11**B of the first body **11** and the first engaging teeth **20** of the holder **12** and having a plurality of (twelve in the present embodiment) second engaging teeth **21**A for engaging respective circumferentially slanted surfaces **20**A of the first engaging teeth **20**, and a ring-shaped bushing **22** (see FIGS. **1** and **6**) fixedly disposed on the inner circumferential surface of the first shell **13** between the first and second engaging teeth **20**, **21**A and having a plurality of (twelve in the present embodiment) third engaging teeth **22**A for engaging respective circumferentially slanted surfaces **21**B of the second engaging teeth **21**A to rotate the first ring **21** circumferentially.

A second ring **23** adjacent to the first ring **21** is axially slidably mounted on the proximal end of the holder **12**. Under the bias of the helical spring **14**, the second ring **23** together with the holder **12** moves the first body **11**, holding the first ring **21** resiliently against the bushing **22**.

The relationship between the holder **12**, the first ring **21**, and the bushing **22** in the first holding mechanism **18** will further be described below with reference to FIGS. **1** through **8**. As shown in FIG. **1**, the radially outward fingers **19** of the thicker portion **12**B of the holder **12** are spaced from the bushing **22** toward the distal end, with the bushing **22** being disposed between the first engaging teeth **20** of the holder **12** and the second engaging teeth **21**A of the first ring **21**.

As shown in FIG. **4**(*a*), the six radially outward fingers **19** are spaced at equal intervals in the circumferential directions of the holder **12** (at intervals of 60° in the circumferential directions). As shown in FIG. **4**(*a*), the twenty-four first engaging teeth **20** are spaced at equal intervals in the circumferential directions (at intervals of 15°). As shown in FIG. **4**(*b*), each of the radially outward fingers **19** is positionally displaced circumferentially a slight angle from one of the first engaging teeth **20**. The six radially outward fingers **19** jointly define an outside diameter smaller than the outside diameter of the bushing **22**. As shown in FIGS. **6**(*a*) and **6**(*b*), gaps **22**B between the third engaging teeth **22**A include cavities **22**C circumferentially spaced at intervals of 60°, and the radially outward fingers **19** pass centrally through the cavities **22**C. Each of the gaps is wider than the circumferential width of the first engaging teeth **20**. The twenty-four first engaging teeth **20** jointly define an outside diameter slightly smaller than the inside diameter of the third engaging teeth **22**A. The slanted surfaces **20**A which are slanted downwardly circumferentially are provided on the projecting end faces of the first engaging teeth **20**, as shown in FIG. **3**(*b*).

As shown in FIGS. **5**(*a*) through **5**(*c*), the twelve second engaging teeth **21**A of the first ring **21** are circumferentially spaced at equal intervals (intervals of) 30°) on a ring body **21**C. As shown in FIGS. **5**(*a*) through **5**(*c*), the second engaging teeth **21**A project from both the outer circumferential surface and one surface (upper surface in FIG. **5**(*b*)) of the ring body **21**C. As shown in FIGS. **5**(*a*) and **5**(*c*), the second engaging teeth **21**A project radially outwardly from the ring body **21**C as viewed in plane. The second engaging teeth **21**A have a circumferential width greater than the radially outward fingers **19**, and are of substantially the same dimension as the gaps **22**B between the adjacent ones of the third engaging teeth **22**A of the bushing **22**, so that the second engaging teeth **21**A are fitted in the gaps **22**B. Half of the twelve gaps **22**B have the cavities **22**C, and the remaining half of the twelve gaps **22**B have bottom surfaces **22**D on the distal end. Specifically, as shown in FIGS. **6**(*b*) and **6**(*d*), the bushing **22** has the cavities **22**C and the bottom surfaces **22**D arranged alternately circumferentially.

The twelve second engaging teeth **21**A jointly define an outside diameter that is substantially the same as the outside diameter jointly defined by the twelve third engaging teeth **22**A. Each of the second engaging teeth **21**A has a radial width greater than the radial width of the third engaging teeth **22**A.

In the state shown in FIG. **1**, therefore, since the holder **12** is normally biased toward the distal end by the helical spring **14**, the first ring **21** is pressed by the second ring **23** to cause the second engaging teeth **21**A to be fitted into the gaps **22**B of the bushing **22** and resiliently held against the bottom surfaces **22**D, holding the first engaging teeth **20** in a position spaced from the bushing **22** toward the distal end. The gaps **22**B of the bushing **22** are thus defined as fitting grooves **22**B.

The second and third engaging teeth **21**A, **22**A have slanted surfaces **21**B, **22**E provided on respective projecting end

faces and slanted downwardly circumferentially. The second engaging teeth **21**A and the third engaging teeth **22**A engage each other with their slanted surfaces **21**B, **22**E. The slanted surfaces **21**B of the second engaging teeth **21**A are contacted by the slanted surfaces **20**A of the first engaging teeth **20** of the holder **12** inwardly of the radially outward fingers **19**. The circumferential length of the slanted surfaces **22**E of the third engaging teeth **22**A is greater than the circumferential length of the slanted surfaces **21**B of the second engaging teeth **21**A. Under the bias of the helical spring **14**, the slanted surfaces **21**B are pushed by the slanted surfaces **22**E to slide, causing the first ring **21** to rotate in the slanted direction.

As shown in FIG. **6**(*b*), the slanted surfaces **22**E of the third engaging teeth **22**A have engaging portions on their extension ends for stopping the second engaging teeth **21**A against sliding movement. The engaging portions have on their projecting end faces slanted surfaces **22**F that are slanted at substantially the same angle as the slanted surfaces **22**E. The slanted surfaces **22**F are shorter than the slanted surfaces **22**E. The slanted surfaces **22**E and the slanted surfaces **22**F have respective upper ends at the same height. The slanted surfaces **22**F have a function to guide the second engaging teeth **21**A into the fitting grooves **22**B.

Operation to install the plug **50** on the receptacle connector **10** and remove the plug **50** from the receptacle connector **10** will be described below also with reference to FIGS. **7** and **8**.

With the receptacle connector **10** fixed to the panel (not shown), the ball **16** projects from the hole **12**D in the holder **12**, as shown in FIG. **1**, and the radially outward fingers **19** are spaced from the bushing **22** toward the distal end. Under the bias of the helical spring **14**, the first ring **21** is resiliently held against the bushing **22** by the second ring **23**. At this time, the second engaging teeth **21**A of the first ring **21** are resiliently held against the bottom surfaces **22**D of the fitting grooves **22**B in the bushing **22**, and are disposed in the fitting grooves **22**B.

For connecting the plug **50** to the receptacle connector **10** shown in FIG. **1**, the groove **52**B in the second shell **52** is aligned with the ridge **12**E on the holder **12**, and the second shell **52** is inserted into the clearance between the holder **12** and the first shell **13**. The distal end of the second shell **52** hits the ball **16** projecting from the holder **12**, after which the bias of the helical spring **14** acts on the plug **50**. When the plug **50** is inserted against the bias of the helical spring **14**, the holder **12** slides the first body **11**, and the radially outward fingers **19** of the holder **12** move into the cavities **22**C of the bushing **22**.

At this time, since the second engaging teeth **21**A of the first ring **21** are positioned in the cavities **22**C (the cavities **22**C are also the fitting grooves **22**B), the first engaging teeth **20** and the second engaging teeth **21**A contact each other through the respective slanted surfaces **20**A, **21**B thereof, the first ring **21** moves toward the proximal end, then the radially outward fingers **19** move into the cavities **22**C. At the time the radially outward fingers **19** move into the cavities **22**C, the radially outward fingers **19** and the second engaging teeth **21**A have their central lines across the circumferential widths thereof held in alignment with each other, as shown in FIG. **7**(*a*), with the first engaging teeth **20** being displaced to and held against the right sides of the second engaging teeth **21**A. They remain in the state shown in FIG. **7**(*a*) until the radially outward fingers **19** reach the upper ends of the slanted surfaces **22**E of the third engaging teeth **22**A of the bushing **22**.

When the upper ends of the radially outward fingers **19** reach the upper ends of the slanted surfaces **22**E of the third engaging teeth **22**A, as shown in FIG. **8**(*b*), the second engaging teeth **21**A are not constrained by the fitting grooves **22**B. As the second engaging teeth **21**A are resiliently pressed against the first engaging teeth **20** by the helical spring **14**, the first ring **21** is turned clockwise in FIG. **7**(*a*) or to the right in FIG. **8**(*b*) along the slanted surfaces **20**A of the first ring **21** onto the slanted surfaces **22**E of the third engaging teeth **22**A. Since the slanted surfaces **21**B of the second engaging teeth **21**A are shorter than the slanted surfaces **22**E of the third engaging teeth **22**A, the first ring **21** slides on the slanted surfaces **22**E under the action of the helical spring **14**, and turns up to the engaging portions where it stops. At this time, the ball **16** of the holder **12** is retracted into the recess **11**E, the second shell **52** of the plug **50** moves beyond the hole **12**D of the holder **12** into contact with the radially outward fingers **19** of the holder **12**, and the hole **52**A of the second shell **52** reaches a position immediately above the ball **16**.

After the first ring **21** is stopped against turning movement by the engaging portions, when the plug **50** is pushed in against the bias of the helical spring **14**, the first ring **21** moves toward the proximal end while in contact with the first engaging teeth **20**. The slanted surfaces **21**B of the second engaging teeth **21**A disengage from the engaging portions, and the first ring **21** turns in the direction described above. The second engaging teeth **21**A are guided by the slanted surfaces **22**F of the engaging portions to reach the fitting grooves **22**B. The second engaging teeth **21**A are fitted into the fitting grooves **22**B and move toward the distal end until they reach the bottom surfaces **22**D. At this time, the holder **12** is also moved toward the distal end by the helical spring **14**, during which time the ball **16** returns from the recess **11**E into the hole **12**D and projects into the hole **52**A of the first shell **52** of the plug **50**, whereupon the plug **50** is connected to the holder **12**, i.e., the receptacle connector **10**.

For removing the plug **50** from the receptacle connector **10**, the plug **50** is pushed into the receptacle connector **10**. As described above, the instant the second engaging teeth **21**A of the first ring **21** come out of the fitting grooves **22**B of the bushing **22**, they turn and stop on the slanted surfaces **22**E of the third engaging teeth **22**A of the bushing **22**. At this time, the ball **16** is retracted from the second shell **52**A of the plug **50** and enters the recess **11**E of the first body **11**. The plug **50** is then pushed in again. When second engaging teeth **21**A are guided by the slanted surfaces **22**F of the engaging portions and fitted into the fitting grooves **22**B, the ball **16** is positioned in the recess **11**E and displaced out of engagement with the second shell **52**A. Therefore, the plug **50** can simply be pulled out of the holder **12**.

According to the present embodiment, as described above, the receptacle connector **10** includes the first holding mechanism **17** for holding the plug **50** connected to the holder **12** by fitting the ball **16** disposed in the hole **12**D defined in the holder **12** into the hole **52**A defined in the second shell **52** of the plug **50** through the recess **11**E defined in the outer circumferential surface of the first body **11**, and the second holding mechanism **18** for coacting with the first holding mechanism **17** to keep the plug **50** and the holder connectable to and releasable from each other. Therefore, the user can simply connect the plug **50** to the receptacle connector **10** and remove the plug **50** from the receptacle connector **10**, and reliably prevent the plug from being pulled out of the receptacle connector, simply by pushing the plug **50** into the holder **12** of the receptacle connector **10** with one hand, without performing a complex process of operating a lever with one hand and installing and removing the plug with the other hand as is the case with the receptacle connector according to the background art.

The present invention is not limited to the above embodiment, but various components may be changed in design if necessary.

DESCRIPTION OF REFERENCE CHARACTERS

10 receptacle connector
11 first body
11A pin hole
11E recess
12 holder
12A thinner portion
12B thicker portion
12D hole
13 first shell
14 helical spring
16 ball
17 first holding mechanism
18 second holding mechanism
19 radially outward finger
20 first engaging tooth
20A slanted surface
21 first ring
21A second engaging tooth
21B slanted surface
22 bushing
22A third engaging tooth
22B fitting groove
22C cavity
22E slanted surface
22F slanted surface
23 second ring
50 plug
51 pin
52 second shell
52A hole

The invention claimed is:

1. A receptacle connector comprising:

a first body having a pin hole for inserting therein a pin of a plug for electrical connection thereto;

a tubular holder having a thinner portion disposed on a proximal end side thereof and a thicker portion disposed on a distal end side portion thereof with a step interposed therebetween, said tubular holder being slidable along said first body;

a tubular first shell having an end fixed to a large-diameter portion on a proximal end of said first body and another end extending to a distal end of the holder;

a helical spring resiliently disposed between said large-diameter portion on the proximal end of the first body and a proximal end of the holder;

a stop ring for preventing the holder biased by said helical spring from being dislodged from said first body;

a first holding mechanism for holding the plug connected to the holder by fitting a ball disposed in a hole defined in the holder into a hole defined in a second shell of the plug through a recess defined in an outer circumferential surface of the first body; and

a second holding mechanism for coacting with the first holding mechanism to keep the plug and the holder connectable to and releasable from each other;

wherein when the plug is pushed in between the holder and the first shell against the bias of the helical spring, the first holding mechanism is actuated to fix the plug to the holder and the second holding mechanism holds the plug and the holder connected to each other;

when the plug is pushed in against the bias of the helical spring while the plug and the holder are connected to each other, the second holding mechanism releases the plug and the holder from each other and the first holding mechanism is actuated to release the plug and the holder from each other;

the second holding mechanism comprising:

a plurality of radially outward fingers projecting radially outwardly from a circumferential surface of the thicker portion side of said step of the holder and circumferentially spaced at equal intervals;

a plurality of first engaging teeth projecting from an end face of the step of the thicker portion of the holder toward the proximal end side and circumferentially spaced at equal intervals, the first engaging teeth being circumferentially displaced from the radially outward fingers by a predetermined angle;

a first ring rotatably disposed between the large-diameter portion on the proximal end of the first body and the first engaging teeth of the holder and having a plurality of second engaging teeth engaging circumferentially slanted surfaces of the first engaging teeth; and

a bushing positioned on an inner circumferential surface of the first shell between the first and second engaging teeth and having third engaging teeth for engaging circumferentially slanted surfaces of the second engaging teeth to rotate the first ring circumferentially;

wherein said bushing has a plurality of cavities defined in an inner circumferential surface thereof for passing therein the radially outward fingers and fitting grooves defined in the inner circumferential surface thereof for allowing the second engaging teeth to move into and out of the fitting grooves.

2. A receptacle connector according to claim **1**, wherein the third engaging teeth of the bushing has slanted surfaces circumferentially longer than the slanted surfaces of the second engaging teeth of the first ring, and engaging portions disposed on respective extension ends of the slanted surfaces for stopping the first ring against rotation.

3. A receptacle connector according to claim **1**, wherein the first engaging teeth have a width representing the sum of widths of at least the radially outward fingers and the second engaging teeth disposed inwardly of the radially outward fingers.

4. A receptacle connector according to claim **2**, wherein the engaging portions of the third engaging teeth have, on projecting ends thereof, slanted surfaces for guiding the second engaging teeth into the fitting grooves.

5. A receptacle connector according to claim **1**, wherein the first holding mechanism includes the ball removably disposed in the hole defined in the thicker portion of the holder, for being fitted into the hole defined in the plug to connect the plug to the holder, and the recess defined in the outer circumferential surface of the first body for receiving the ball retracted therein while the ball is disposed in the hole of the holder which slides against the helical spring.

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